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PRELIMINARY GEOLOGICAL MAP AND NOTES, YELVERTON INLET MAP-AREA, DISTRICT OF FRANKLIN (NTS 340F, 540G)

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REMARKS ON AGE ASSIGNMENTS AND STRATIGRAPHIC NOMENCLATURE

Proterozoic

Samples from the gneiss belt between Yelverton Inlet and Ayles Fiord (map-unit Pn) gave a whole-rock Rb/Sr isochron age of 742 ± 12 Ma, interpreted as a minimum age (Sinha and Frisch, 1975). A lithologically similar gneiss belt at Cape Columbia (Clements Markham Inlet map-area) gave a Rb/Sr isochron age of 1083 ± 18 Ma and discordant zircon ages of 926 and 980 Ma (Sinha and Frisch, 1976). Zircon determinations on samples from the present area are in progress.

Proterozoic and/or lower Paleozoic

The units in this category constitute a thick and lithologically varied assemblage of predominantly metasedimentary rocks with lesser amounts of metavolcanic rocks. Most are metamorphosed in the lower greenschist facies but some in upper greenschist or amphibolite facies. The structure is so complex that the internal stratigraphy could not be established, except for a small area east of Milne Fiord. Fossils and trace fossils are lacking and radiometric age determinations have not yet been made. The external contacts are faulted. For these reasons the various map-units distinguished are denoted by lower case italicized (i.e. underlined) letter symbols only indicating lithology, without the customary upper case letters indicating age. Some map-units represent recurrent lithologies of different ages, others represent rock units present in one area only.

Three stratigraphic units of formational rank are recognized in the area east of Milne Fiord. They are informally referred to as units 1, 2 and 3 of the Milne Fiord assemblage and marked by numbers that follow the lithological letter symbols.

Unit 1 (map-unit c 1) consists of more than 150 m of microcrystalline limestone or marble with lesser amounts of dolomitic limestone or marble and dolostone. The rocks are distinctly to faintly laminated.

INTRODUCTION

Phillips Inlet map-area, together with the adjacent M'Clintock Inlet map-area, probably is geologically the most difficult part of the Arctic Islands because of its extremely complex structure and scarcity of fossils.

Initial geological reconnaissance work in parts of the area was done by Christie (1957) in 1954, Trettin (1972) in 1962 and 1966, and Frisch (1974) in 1965 and 1966.

The present compilation is based on the earlier publications and field work in 1975, 1977 and 1980. It forms part of a program of the Geological Survey of Canada to complete the reconnaissance of nine map-areas in northern Ellesmere Island (Project 730051).

In 1975 a base camp was occupied on the delta southwest of the head of Kulutingwak Fiord for about one month. Frisch (1976) spent all of this time in the present map-area and Trettin (1976a, b) half of it. The work consisted mainly of foot traverses out of fly camps with a few helicopter traverses, using a Bell G 4A machine. D.G. Wilson (1976) briefly examined Tertiary strata at Yelverton Bay. The mapping was completed by Trettin during six days of helicopter traversing in 1977 and 1980, using Bell 206B machines out of base camps at Clements Markham Inlet and Tanquary Fiord.

To date, age determinations, petrographic and chemical analyses and interpretations of the depositional and structural history are in various stages of preparation; they will be published at a later time. The following notes are merely intended to explain age assignments and stratigraphic nomenclature on the map legend.

Unit 2 (map-unit p 2) comprises about 640 m of pelitic slate or phyllite with lesser proportions of tuffaceous phyllite and silty and sandy original limestone and dolostone.

Unit 3 (map-unit q 3) has a minimum thickness of about 560 m and consists almost entirely of very fine to medium grained orthoquartzite, locally with pelitic slate in the lower few metres.

In the adjacent Ayles Fiord region of the M'Clintock Inlet map-area, unit 1 is underlain by metamorphosed mudrocks, volcanics, and carbonates that are similar to units 1 and 2 but unquestionably older. This succession locally is overlain with high angular unconformity by the upper Middle Ordovician Cape Discovery Formation, which is different from the Milne Fiord assemblage and all other units discussed here. The implication seems to be that most of these units are pre-late Middle Ordovician age. Map-unit xp west of Yelverton Bay, and map-units x, c, and scqv south and west of upper Kulutingwak Fiord were previously regarded as Early Silurian in age and younger than the Ordovician-Lower Silurian volcanic and carbonate rocks discussed below (Trettin, 1975; Trettin et al., 1979; Trettin and Balkwill, 1979, Fig. 3) but now are interpreted as older.

The quartzites of map-units q (including q 3), pq and scqv have no counterparts in the Cambrian to Silurian succession of northern Ellesmere Island and must be Proterozoic in age if they originated on the North American plate. If they are exotic they could range in age from Precambrian to early Middle Ordovician. (Stratigraphic continuity of this basement complex in general with North America is apparent from late Middle or Late Ordovician time onward.) The diamictites of map-units px and xp are similar to conglomerates in the unfossiliferous Mount Disraeli assemblage of the Clements Markham Inlet area and also have a superficial resemblance to upper Proterozoic diamictites in various

parts of the world regarded as tillites or tilloids. Present petrographic information, however, suggests that they are subaqueous debris flow deposits, with the phenoclasts derived from a carbonate shelf, rather than tillites or ice-rafted dropstone conglomerates. Nevertheless, they are unusual in appearance and probably were produced by unusual events. Rapid and pronounced sea level changes caused by an ice age are a possible explanation.

In contrast to these lithologies of Proterozoic aspect, the dark grey chert beds and associated dark grey mudrocks of map-unit px are similar to parts of the Hazen Formation and, generally, are more comparable to Cambrian to Devonian deep-water successions than to any reported Proterozoic succession in Canada. Map-units va, vc, s* and some associated outcrops of map-unit c combined may be a continuation of the belt underlain by map-units OSsa and OSc on strike to the southwest. However, these units are not definitively assigned to the Ordovician or Silurian because the limestones have not yielded any fossils as yet and because they are not associated with the Imina Formation or other known units of early Paleozoic age.

Lower Silurian and (?) older

Conodonts from a limestone associated with volcanics south of Kulutingwak Fiord (loc. 75T179) are of Early Silurian, early to middle Llandoverian age (C.R. Barnes in Trettin et al., 1979). Limestone lying adjacent to volcanic rocks west of Yelverton Bay (loc. 75T225) yielded a single conodonts fragment (short, wide, acontodiform element; identification by C.R. Barnes, 1977). It is undiagnostic but nevertheless indicates an age no older than Late Cambrian. The volcanic rocks are assumed to be partly Ordovician in age because most volcanic rocks in the M'Clintock Inlet area, and at least some in the Otto Fiord and Tanquary Fiord map-areas, are of that age.

Marble on the peninsula south of Mitchell Point contains echinoderm columnals, which are common only in rocks of Ordovician and younger ages. Structural setting and composition suggest that the marble and associated schist and amphibolite (map-unit OSsa) are metamorphic equivalents of map-units OSv and OSc to the southwest.

Silurian

The Imina Formation has yielded graptolites of late Llandoverian age east of Emma Fiord (Trettin, 1969a) and of unspecified late Llandoverian or Wenlockian age at M'Clintock Inlet (Trettin, 1969b).

In the type area east of Emma Fiord, the Lands Lokk Formation is divisible into three members (Trettin, 1969a). Member A consists mainly of mudrock with minor amounts of tuff and tuffaceous sediments; member B of mudrock, tuff, volcanic flows and lenses of limestone; and member C of mudrock and sandstone with lesser amounts of granule and pebble conglomerate. Member A contains graptolites of unspecified late Llandoverian to Wenlockian and of early Ludlovian age, and member C graptolites of early Ludlovian age. Members A and C are recognized in the present area, but member B is restricted to the vicinity of Emma Fiord.

Devonian or older

Map-unit Ds

Map-unit Ds, composed of serpentinite, that locally has a relic breccia structure, occurs in the core of an anticline south and west of upper Kulutingwak Fiord. It now is interpreted as a diapiric "cold" intrusion of ophiolitic affinity. A

much larger, partly serpentinized ultramafic to granitic intrusion west of M'Clintock Inlet has a K/Ar (hornblende) age of 390 ± 20 Ma[1] (Trettin, 1969b). A zircon determination is in progress.

Map-units Dmum and Dm

The Cape Fanshawe Martin intrusion (map-unit Dmum) has a K/Ar (biotite) age of 376 ± 16 Ma[1] (Frisch, 1974). Gabbroic intrusions on western Wootton Peninsula (map-unit Dm) are comparable to the Cape Fanshawe Martin intrusion in lithology and structural setting; both occur on the northwest side of the same Proterozoic gneiss belt.

Lower Carboniferous or Devonian

Map-unit Dqm

The quartz monzonite intrusion east of Cape Woods has a K/Ar (biotite) age of 345 ± 15 Ma[1] (Wanless et al., 1974). Zircon determinations are in progress.

Hansen Point volcanics

The informal name, Hansen Point volcanics (map-unit Dhp) is here applied to predominantly volcanic rocks northeast and southwest of the mouth of Yelverton Inlet. The weakly deformed and unmetamorphosed state of the rocks indicates that they are younger than the Ellesmerian Orogeny. On the other hand, they differ from most Carboniferous to Cretaceous volcanics of the Sverdrup Basin by their predominantly siliceous composition. They are tentatively interpreted as postorogenic volcanics of Devonian to Early Carboniferous age.

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[1] Uncorrected ages based on decay constants used prior to 1978; corrected values, based on present decay constants, are about 2% older (Dalrymple, 1979), but so are the absolute ages of periods, epochs and stages (Armstrong, 1979).

Lower Tertiary

Eureka Sound Formation

Clastic sediments west of Yelverton Bay, assigned by Christie (1957) to the Eureka Sound "Group" were reexamined by Wilson (1966) in 1975. He distinguished a lower unit, about 500 m thick, composed of mudrock and sandstone and an upper unit, about 200 m thick, composed of sandstone and conglomerate. One florule from the lower unit was of Early Tertiary age, others were of unspecified Maastrichtian to Eocene age. Wilson restricted the Eureka Sound Formation to the lower unit and correlated the upper unit with upper Tertiary conglomerate and sandstone of the Beaufort Formation at Gibbs Fiord, Axel Heiberg Island. However, at Lake Hazen conglomerate and sandstone occur in the upper part of the Eureka Sound Formation (Miall, 1979) and therefore all Tertiary strata west of Yelverton Bay are here assigned to the Eureka Sound Formation.

REFERENCES CITED

Armstrong, R.L.
1978: Pre-Cenozoic Phanerozoic time scale -- computer file of critical dates and consequences of new and in-progress decay constant revisions; in Contributions to the geologic time scale, G.V. Cohee, M.F. Glaessner and H.D. Hedberg, editors; American Association of Petroleum Geologists, Studies in Geology, no. 6, p. 73-91.

Christie, R.L.
1957: Geological reconnaissance of the north coast of Ellesmere Island, District of Franklin, Northwest Territories; Geological Survey of Canada, Paper 56-9.

Dalrymple, G.B.
1979: Critical tables for conversion of K-Ar ages from old to new constants; Geology, vol. 7, p. 558-560.

Frisch, T.
1974: Metamorphic and plutonic rocks of northernmost Ellesmere Island, Canadian Arctic Archipelago; Geological Survey of Canada, Bulletin 229.

1976: Igneous and metamorphic rocks, northern Ellesmere Island; in Geological Survey of Canada, Paper 76-1A, p. 429-430.

Miall, A.D.
1979: Tertiary fluvial sediments in the Lake Hazen intermontane basin, Ellesmere Island, Arctic Canada; Geological Survey of Canada, Paper 79-9.

Sinha, A.K. and Frisch, T.
1975: Whole-rock Rb/Sr ages of metamorphic rocks from northern Ellesmere Island, Canadian Arctic Archipelago. I. The geneiss terrain between Ayles Fiord and Yelverton Inlet; Canadian Journal of Earth Sciences, vol. 12, p. 90-94.

1976: Whole-rock Rb/Sr and zircon U/Pb ages of metamorphic rocks from northern Ellesmere Island, Canadian Arctic Archipelago. II. The Cape Columbia Complex; Canadian Journal of Earth Sciences, vol. 13, p. 774-780.

Trettin, H.P.
1969a: Pre-Mississippian geology of northern Axel Heiberg and northwestern Ellesmere Islands, Arctic Archipelago; Geological Survey of Canada, Bulletin 171.

1969b: Geology of Ordovician to Pennsylvanian rocks, M'Clintock Inlet, north coast of Ellesmere Island, Canadian Arctic Archipelago; Geological Survey of Canada, Bulletin 183.

Trettin, H.P.
1972: Reconnaissance of lower Paleozoic geology, Phillips Inlet region, north coast of Ellesmere Island, District of Franklin; Geological Survey of Canada, Paper 71-12.

1976a: Geological investigations in northern Ellesmere Island, (Reports 91 to 96) Introduction; in Geological Survey of Canada, Paper 76-1A, p. 425-428.

1976b: Reconnaissance of lower Paleozoic geology, Agassiz Ice Cap to Yelverton Bay, northern Ellesmere Island; in Geological Survey of Canada, Paper 76-1A, p. 431-444.

Trettin, H.P. and Balkwill, H.R.
1979: Contributions to the tectonic history of the Innuitian Province, Arctic Canada; Canadian Journal of Earth Sciences, vol. 16, p. 748-769.

Trettin, H.P., Barnes, C.R., Kerr, J.Wm., Norford, B.S., Pedder, A.E.H., Riva, J., Tipnis, R.S., and Uyeno, T.T.
1979: Progress in lower Paleozoic stratigraphy, northern Ellesmere Island, District of Franklin; in Geological Survey of Canada, Paper 79-1B, p. 269-279.

Wanless, R.K., Stevens, R.D., Lachance, G.R. and Delabio, R.N.D.
1974: Age determinations and geological studies K-Ar isotopic ages, report 12; Geological Survey of Canada, Paper 74-2.

Wilson, D.G.
1976: Eureka Sound and Beaufort Formations, Yelverton Bay, Ellesmere Island, District of Franklin; in Geological Survey of Canada, Paper 76-1A, p. 453-455.

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PRELIMINARY GEOLOGICAL MAP, YELVERTON INLET, DISTRICT OF FRANKLIN

(NTS 340 F, 560 E)

LEGEND

QUATERNARY

Q — unconsolidated sediments obscuring bedrock geology

TERTIARY

Early Tertiary

Eureka Sound Formation

Te — sandstone, conglomerate, mudrock

CARBONIFEROUS OR DEVONIAN

Early Carboniferous or Devonian

Dgm — quartz monzonite, granodiorite

? Early Carboniferous or Devonian

Hansen Point volcanics

Dhp — volcanic rocks, siliceous to basaltic

DEVONIAN OR OLDER

Ds — serpentinite

Cape Fanshawe Martin intrusion

Dmum — gabbro, norite, peridotite and related rocks

Dm — gabbro and related rocks

SILURIAN

Early to early Late Silurian (Llandoverian to Ludlovian)

Lands Lokk Formation

Se — sandstone, quartzose, cherty, micaceous; mudrock, slaty; minor pebble and intraformational conglomerate
Sl 1: member A --mainly mudrock, minor sandstone
Sl 3: member C --sandstone, mudrock; minor conglomerate

Imina Formation

Si — sandstone, compositionally immature, calcareous, dolomitic; mudrock, slaty to phyllitic; very small amounts of granule and pebble conglomerate (locally metamorphosed to schist)
Sic: marker beds, calcareous (?)

SILURIAN AND (?) OLDER

Early Silurian and (?) older

OSv — volcanic rocks, siliceous to basaltic, partly metamorphosed in greenschist facies

OSℓ — limestone, variably metamorphosed, locally fossiliferous, associated with volcanic rocks *or schist and amphibolite*

OSsa — schist, mainly of amphibolite grade; amphibolite

OSc — marble (locally crinoidal)

EARLY PALEOZOIC AND/OR PROTEROZOIC

stratigraphic order uncertain except where indicated

a§c — amphibolite, schist, metamorphosed carbonate rocks

c — variably metamorphosed carbonate rocks, mainly original limestone, minor dolostone (recurrent lithological unit)
c 1: Milne Fiord assemblage, unit 1

cd — metamorphosed dolostone

cv — interstratified carbonate and volcanic rocks, metamorphosed mainly in greenschist facies
cv* : metamorphosed in amphibolite facies

m — mafic dyke or sill, probably metamorphosed (mapped from air photograph)

p — phyllite, mainly pelitic, to a lesser extent volcanic in origin; minor carbonate rocks, quartzite (recurrent lithological unit)
p 2: Milne Fiord assemblage, unit 2 (stratigraphic unit)

pq — phyllite, pelitic and quartzite

px — phyllite, pelitic, in part sandy or sandy and conglomeratic (diamictite); minor metamorphosed carbonate rocks, chert; very small amounts of metamorphosed siliceous volcanic rocks

q — quartzite, locally with very small amounts of pelitic phyllite (probably recurrent lithological unit)
q 3: Milne Fiord assemblage, unit 3

qf — quartzite, feldspathic (arkose)

qp — quartzite with lesser amounts of pelitic phyllite

s — schist ,metamorphosed mainly in greenschist facies
s*: metamorphosed in amphibolite facies

sc — schist and carbonate rocks, metamorphosed mainly in greenschist facies

scqv — schist, limestone, quartzite; minor siliceous volcanic rocks (metamorphosed in greenschist facies)

v — volcanic and (?) pelitic rocks, metamorphosed in greenschist facies

vq — mafic volcanic rocks ,metamorphosed in amphibolite facies

x — conglomerate (compositionally related to diamitites)

xp — phyllite, pelitic, in part sandy or sandy and conglomeratic (diamictite); minor carbonate rocks ,metachert

PROTEROZOIC

Hadrynian and/or Neohelikian

Pn — metamorphosed granitic intrusions and pegmatite and associated amphibolite to greenschist-grade metasedimentary and meta-igneous rocks (schist, amphibolite, marble etc.)

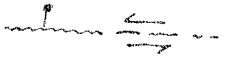
Png: relatively massive resistant; predominantly granitic intrusions

Pns: relatively recessive, layered; includes high proportion of biotite-rich metasediments

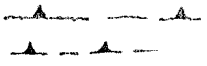
Pc — marble associated with gneisses

Pscn — schist, metamorphosed carbonate rocks; minor gneiss

geological boundary (defined, approximate, assumed; projected through ice or overburden)



fault (defined, approximate, assumed or projected through ice or overburden ; solid circle indicates downthrow side, arrows relative movement)



thrust fault (defined, approximate, assumed or projected through ice or overburden; teeth on hanging wall)

anticline,(arrow indicates plunge)

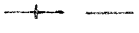
syncline

synform

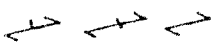
strike and dip of bedding , tops known

strike and dip of bedding, tops unknown; dip estimate from air photographs

- g: gentle (about 3^{o} - 10^{o})
- m: medium (about 10^{o} - 25^{o})
- s: steep (about 25^{o} - 45^{o})
- vs: very steep (about 45^{o} - 89^{o})



vertical, dip unknown



schistosity, gneissosity (inclined, vertical, dip unknown; dip estimates as for bedding)

primary flow structures in igneous rock (vertical)

mafic dykes and sills of different ages; probably in part metamorphosed (mapped from air photographs)

helicopter landing, outcrop observation or sample locality*

fossil locality

Geology by T.O.Frisch,1975, H.P.Trettin, 1975,1977, 1980 and D.G.Wilson,1975

Compiled by H.P.Trettin and T.O.Frisch, April,1981

(partly based on Trettin,1972, Frisch, 1974)

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* locations visited by Frisch are not shown